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GUIDE FOR CODING DRILLHOLE DATA FROM URANIUM DEPOSITS, VERSION 3

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MICROMEDIA

GUIDE FOR CODING DRILLHOLE DATA FROM URANIUM DEPOSITS VERSION 3*

by

Raymond Sabourin**

ABSTRACT

The reader is first introduced to the idea that computer data processing must be used to calculate, on an annual basis, the uranium reserves of the country.

The coding system is then described in detail, and the variables belonging to four coding sheets are defined seperately.

Coding procedures of basic data are explained and MEG codes are given for a number of variables.

Finally, three fictive examples are presented and the most significant details in coding the data are discussed.

Key words: Uranium Deposits, Drilling Data, Coding System.

* Version 1 was entitled: Draft Guide for Coding drillhole Data from Uranium Deposits, Report No. ERP/MRL 76-74(TR)
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GUIDE POUR LA CODIFICATION DES DONNEES DE SONDAGES POUR LES GISEMENTS URANIFERES VERSION 3*

par

Raymond Sabourin**

RÉSUMÉ

Le lecteur est premièrement introduit à l'idée que l'informatique doit être utilisé afin de calculer, sur une base annuelle, les réserves uranifères du pays.

Le système de codification est décrit en détails et les variables appartenant à quatre feuilles de codification y sont definies séparement.

Les procédures de base pour la codification des données sont expliquées ainsi que les codes à utiliser pour certaines variables.

Finallement, trois examples fictifs sont présentés et les plus important détails pour la codification sont discutés.

Mots Clés: Gisements Uranifères, Données de Sondages, Système de Codification.

* La version 1 était intitulée: Draft Guide for Coding Drillhole Data from Uranium Deposits, Report No. ERP/MRL 76-74(TR).
La version 2 a le mêne titre que la version 3, Report No. ERP/MRL 78-42(OP).

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CHAPTER 1

INTRODUCTION

Calculating the uranium reserves of Canada on an annual basis is virtually impossible with manual methods. The tremendous amount of sampling data which accumulates in any year, forms merely the tip of the iceberg in every case where a mining company has been active for several years. Yet, to make an intelligent and reliable estimation, the total amount of accumulated data must be taken into account. This circumstance, together with the variation in cut-off grade affected by the change in uranium price as well as inflationary increase of operating and capital costs, make it imperative to use computer data processing in uranium reserve estimations.

Methods of recording sampling data presently used by the mining industry do not lend themselves directly to computer utilization.

The Mine Evaluation Group (MEG) of the Mining Research Laboratories, CANMET, devised a coding system which makes sampling data available for computer processing. At the same time, the system preserves the accessibility of the same data for everyday usage in a mine office. The coding system consists of a set of four Sample Codification Sheets.

In addition to making the data available for reserves estimation, this coding system could potentially result in several other benefits:

- A company wishing to apply computer methodology to its operations would have its data already available in a commputer-accessible form.
- The data could be retrieved rapidly and selectively for:
  - cost calculations of drilling programs
  - short range mine planning
  - structural, statistical and economic analysis
  - automatic plotting of isopach, isopleth and straturm contour maps
  - automatic plotting of geological sections, etc.

This list can be, and we believe will be, extended by imaginative mining professionals according to their individual and special needs. Certainly, ore reserve estimation and mine planning can be speeded up by electronic data processing.

The Sample Codification Sheets were devised to be used in most sampling situations. Therefore, each company need only code the information pertinent to its particular operation.

Some of the data to be coded on the sheets necessitates the attention of a geologist or a mining engineer. Other information can be filled in routinely by clerical personnel.

At present, MEG's coding projects are essentially divided in two:

- The continuous coding of presently accumulating data, including the minor backlog already accumulated on recently commenced exploration and development projects.
- Codification of old data stored in the archives of mining companies with extended exploration, development or production backgrounds. Such data may be used in special projects and studies. A good example would be the evaluation of material left in mined-out areas due to the lower uranium prices in the past.

All columns to be used on the Sample Codification Sheets are labeled. Where the demand for brevity made some obscurity unavoidable, this pamphlet will serve as a tool for clarification. However, the majority of the column labels are self-explanatory.

Several examples of coding data are given in Chapter 4 to show how the coding system is applicable to various types of problems. A short discussion follows each example.

CHAPTER 2

SAMPLE CODIFICATION SHEETS

GENERAL

There are four types of Sample Codification Sheets:

- Title Sheet has three lines. The information coded on these lines identifies and generally describes a drillhole or a collection of samples used as a drillhole. (Throughout this pamphlet, "drillhole" will replace the phrase "drillhole or a collection of samples used as a drillhole"). There is only one Title Sheet for every drillhole.

- The sheet for Dip and Azimuth Measurements of the Hole immediately follows the Title Sheet. This sheet is optional because one can also directly code on Sheet B the dip and azimuth of each segment. The line numbers start at 4 and the sheet identifier is the same as the title sheet, i.e., a space in column 8. To be used, two dip and azimuth measurements of the hole must be recorded on this sheet. Normally, the last measurement is at the end of the hole. The values are recorded numerically in degrees, e.g., 10.5°. The number of dip and azimuth measurements in a hole is written in columns 45 and 46 of line 1 of the Title Sheet. If Sheet B is used instead of sheet DAMH, columns 45 and 46 should be left blank. If more than one sheet is needed, each new sheet must begin with the line number 24, 44, etc.

- Sheets A and B contain information about each sampled segment of a drillhole. The geological and technical information about the segment is coded on Sheet A. The assay data for the same segment is coded on the corresponding line of Sheet B. Up to 20 consecutive segments can be coded on one pair of Sheets A and B. A maximum of 999 segments can be coded if the line number columns are used. Much more segments could be coded if the intercalation column would also be used.

The Sample Codification Sheets are colour-coded for easier identification. The coding system is flexible enough to allow addition of new sheet types should they be required in the future.

DETAILED DESCRIPTION OF TITLE SHEET - LINE 1

MEG Drillhole Number (MDN)

Columns 1 to 7 — MDN must be entered. The first three columns are occupied by letters representing a series. The other four columns will be occupied by numbers from 1 to 9999. The same series will be assigned to no more than one mine. When a mine has used all 9999 possible drillhole numbers in a series, the Mine Evaluation Group will assign an additional series to the mine. For example, mine "X" has series "AAA", mine "Y" has series "AAB" and mine "Z" has series "AAC". If mine "X" has used all 9999 possible numbers in the series "AAA", MEG will assign the series "AAD", in addition to the series "AAA", to mine "X".

Line Number (LN)

Column 11 — Always 1 (pre-printed).

Company Drillhole Number (CDN)

Column 13 to 19 — This is the company's identification of the drillhole.

Number of Continuous Drillholes (NOCD)

Column 20 — Several drillholes (maximum three) may be combined to form one drillhole; e.g., an upward DDH, chip samples and a downward DDH (See example 1 in chapter 4). They can be coded as one drillhole or as separate drillholes. In the latter case, their MDN's must be consecutive. For example, MEG Drillhole number AAA0024 is given to the upward drillhole, AAA0025 to the chip samples and AAA0026 to the downward drillhole. NOCD for the first drillhole of the combination must show how many drillholes are to be combined. In the above example, NOCD for drillhole AAA0024 will be three. The NOCD's for drillholes AAA0025 and AAA0026 will remain blank.

NOTE: If the combined drillholes are coded as one, the NOCD remains blank.

Special Identification of Drillhole (SIOD)

Columns 21 to 26 — The SIOD may be entered at company's option. The plan of the mineral deposit may be divided into a special grid pattern of unit squares. The SIOD will identify the drillhole as well as its location using a special grid pattern. Two letters followed by two digits identify the unit square in which the drillhole is located. The last two digits identify the drillhole within the unit square. For example, SIOD AB3303 indicates that the drillhole is located in unit square AB33 and is assigned the number 03 in that unit square (Fig. 1). In a very dense drilling pattern, the SIOD provides a quick and easy way to locate the drillhole.

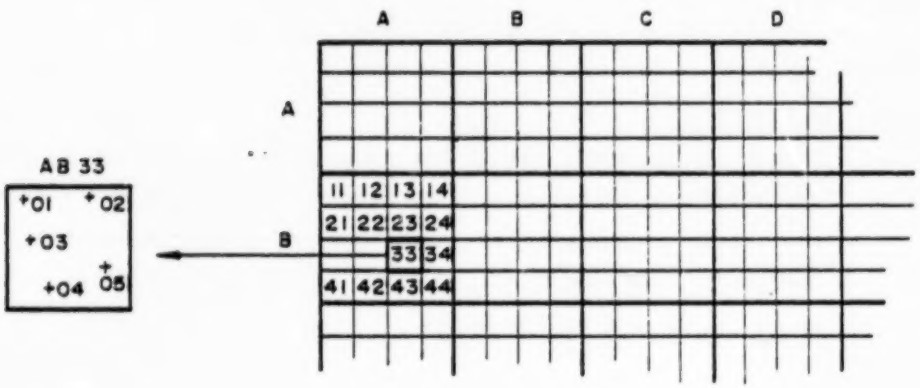

Fig. 1 - Special identification of drillhole (SIOD).

Unit Codes (UC)

Columns 27 to 30 — These codes specify the measuring units for length, grades of uranium and thorium, and density, used to code the information of this drillhole.

Length 1 gives the units for departure, latitude and elevation. Length 2 gives the units for all other measurements of length (e.g., length of segments). These codes are specified by MEG (see MEG Codes, page 19) and must be entered.

Codes for Other Metals (CFOM1,....CFOM5)

Columns 31 to 40 — These codes identify the metals, other than uranium or thorium, that have been assayed. The grades and their assaying methods for these metals must appear on Sheet B, columns 46 to 75, in the same order as the codes for the metals. The metal codes are assigned by MEG (see MEG Codes; page 20).

Number of Dip and Azimuth Measurements in the Hole (NDAMH)

Columns 45 to 46 — The columns are left blank if sheet DAMH is ignored. The dip and azimuth of each segment of Sheet A must then be provided.

Type of Instrument (TI)

Column 47 — This code gives the type of instrument used to measure the dip and azimuth of the hole (see MEG Codes, page 22).

Length of Drillhole (TL)

Columns 48 to 54 — TL must be entered. It is the total length of the drillhole. If the drillhole contained one or more "wedges", the TL is the sum of the length of the original drillhole and the lengths of all "wedges". The length of a "wedge" is measured from the deflection point to the end of the wedge.

Number of Segments (NSEG)

Columns 55 to 57 — Represents the total number of segments (mineralized or not) in the hole. Waste can be considered as a segment with no grade. NSEG must be entered.

Dip of Mineralized Zones (DMZ)

Columns 58 to 59 — DMZ is the dip of mineralized zones in the vicinity of the drill-hole. The dip of a mineralized zone has a positive sign downward from the horizontal plane (see Fig. 2).

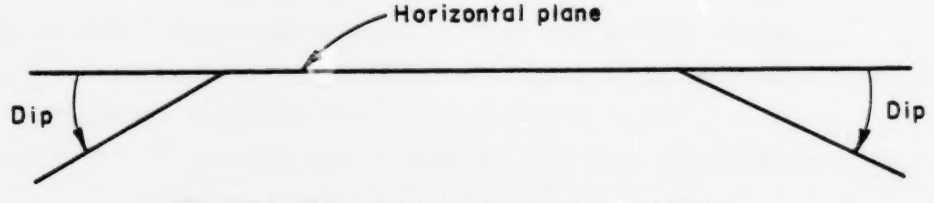

Fig. 2 - Dip of Mineralized Zones (DMZ)

Azimuth of the Dip of Mineralized Zones (ADMZ)

Columns 60 to 62 — The ADMZ is measured clockwise from the north of a coordinate system. ADMZ is the azimuth of the dip of the mineralized zones in the vicinity of the drillhole.

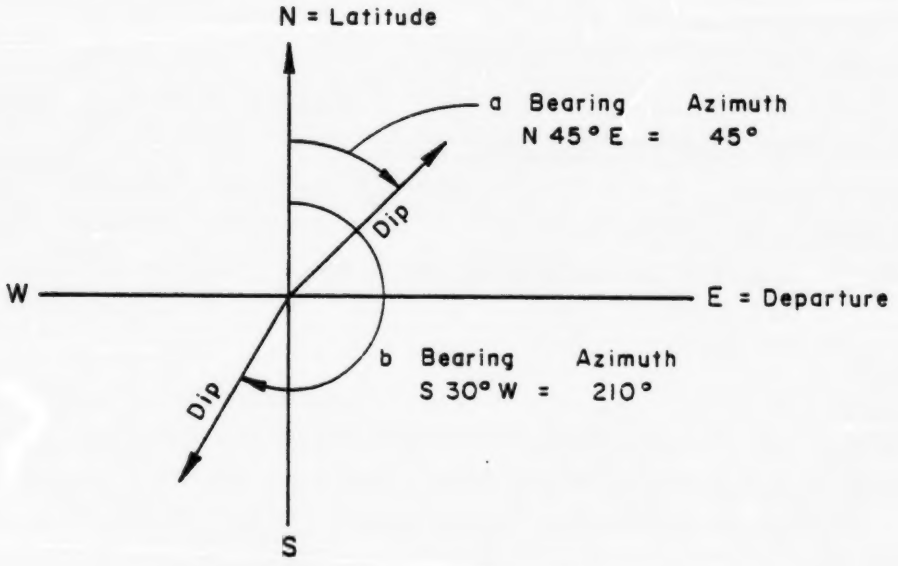

Fig. 3 - Azimuth of the Dip of Mineralized Zones (ADMZ)

Date Started (DS)

Columns 63 to 68 — Six columns to represent the date which the samples (chip, channel, etc.) were taken. For a percussion drillhole or a diamond drillhole it is the date which the drilling was started.

Columns 63-64 year
65-66 month
67-68 day.

Date Completed (DC)

Columns 69 to 74 — Six columns to represent the date which sampling, the DDH or percussion DH was completed.

Columns 69-70 year
71-72 month
73-74 day.

Reserved for MEG Use

Columns 77 to 80 — These columns should be left blank.

DETAILED DESCRIPTION OF TITLE SHEET - LINE 2

Line Number (LN)

Column 11 — Always 2 (pre-printed).

Departure (DEP)

Columns 14 to 20 — The departure must be entered. It is the "Easting" of the collar of the drillhole in a mine co-ordinate system or in the Universal Transverse Mercator System (UTM).

Latitude (LAT)

Columns 21 to 27 — The latitude must be entered. It is the "Northing" of the collar of the drillhole in a mine co-ordinate system or in the UTM system.

Collar Elevation (CEL)

Columns 28 to 34 — The elevation must be entered. It is the elevation of the drillhole collar.

DDH Code Symbol (DDHCS)

Columns 54 to 56 — Self-explanatory. e.g., XRT, BW, etc.

Diameter of Hole other than DDH (DØH)

Columns 57 to 60 — It is the diameter of a drillhole other than DDH. If this diameter is given, it must be given in inches or millimeters, depending on the unit code Length 2.

Initial Casing - DDH Code Symbol (ICCS)

Columns 61 to 63 — Enter here the code symbol for the casing used (e.g., BW, BX, etc.) If more than one casing was used for this drillhole, give the code for the initial casing.

Inital Length of Casing (ILØC)

Columns 64 to 68 — The length of casing is the distance (in feet or meters) from the drillhole collar to the bottom of the casing. This information must be entered if the code for casing size above is also entered. If more than one casing was used, give the length of the initial casing.

Final Casing - DDH Code Symbol (FCCS)

Columns 69 to 71 — If more than one casing was used, give the code of the final casing.

Final Length of Casing (FLØC)

Columns 72 to 76 — If more than one casing was used, enter the length of the final casing.

Reserved for MEG Use

Columns 77 to 80 — Self-explanatory.

DETAILED DESCRIPTION OF TITLE SHEET - LINE 3

Line Number (LN)

Column 11 — Always 3 (pre-printed).

General Information (GI)

Columns 13 to 76 — This can be a general comment about the location of the drillhole or any other general information.

Reserved for MEG Use

Columns 77 to 80 — Self-explanatory.

DETAILED DESCRIPTION OF SHEET DAMH - DIP AND AZIMUTH MEASUREMENTS OF HOLE

MEG Drillhole Number (MDN)

Columns 1 to 7 — MDN must be entered at the top of the sheet only. However, the keypunch operator should be aware that MDN must be keypunched for each line number. It is always the same as MDN on the title sheet line 1.

Line Number (LN)

Columns 10 to 11 — The line numbers start with four and for the first sheet ends with 23. If a second sheet is needed the first line number of that second sheet would be 24 and the last line number 43.

Intercalation (INT)

Column 12 — This column may be used to intercalate one or several lines in the sequence of the dip and azimuth measurements of the hole.

Distance from Collar to Measurements (DFCTM)

Columns 13 to 20 — It is the distance from the collar to the dip and azimuth measurement of the hole. It is always a positive value.

Dip Measurements of Hole (DMØH)

Columns 21 to 30 — The dip of the hole is downward negative and upward positive. Its value is recorded numerically in degrees, e.g., 10.5°.

Azimuth Measurements of Hole (AMØH)

Columns 31 to 40 — The angle representing the azimuth (in degrees) of the hole is measured clockwise from the geographical north. Its value is also recorded numerically in degrees.

Wedge Identification (WI)

Column 8 — This column identifies a dip and azimuth measurement along a wedge. Write (1) for the first wedge, (2) for the second, etc. The first dip and azimuth measurement of a wedge should always be at the beginning of the wedge.

Comments (Cø)

Columns 42 to 77 — These columns can be used as a continuation of line three of the Title Sheet only if dip on azimuth measuremets of the hole are recorded on Sheet DAMH.

Reserved for MEG Use

Columns 77 to 80 — Self-explanatory.

DETAILED DESCRIPTION OF SHEET A

MEG Drillhole Number (MDN)

Columns 1 to 7 — MDN must be entered at the top of the sheet only. However, the keypunch operator should be aware that MDN must be keypunched for each line number. It is always the same as the MDN on the Title Sheet - line 1.

Sheet Type (ST)

Column 8 — Always A (pre-printed) and keypunched for each line number.

Line Number (LN)

Columns 9 to 11 — A maximum of 999 lines can be entered only if the line number is used. More line numbers could be used if the intercalation column would also be used.

Intercalation (INT)

Column 12 — This column is used to insert from one to nine additional segments between two already coded segments. This column will be used in case one or more segments were omitted when coding the drillhole

information or when more than 999 segments are to be coded. The use of the intercalation column avoids renumbering the segments after they have been coded. For example, when a drillhole of 50 segments has been coded, all lines are numbered consecutively from 1 to 50. Then it is found that two segments were overlooked and that they should be inserted after the 10th segment. Rather than having to resequence the segments already numbered 11 to 50, the intercalation column may be used to insert the two segments:

Line Number	Intercal.
1	
2	
:	
50	
10	1
10	2

Note: A) The numbers of segments (NSEG) on the Title Sheet - line 1 must include the intercalated segments. (NSEG = 52 in the above example.)

b) The line numbers and intercalations must be the same on Sheets A and B for the same segment.

Wedge Identification (WI)

Column 13 — This column identifies a "wedge" of the drillhole. Write (1) for the first wedge, (2) for the second etc.

Sample Number (SN)

Columns 14 to 23 — A company number assigned normally to an assay.

Sampling Method (SM)

Column 24 — This code is used to differentiate between DDH, blast hole, channel sample, etc. (see MEG Codes, page 20).

Distance from Collar (DFC)

Column 25 to 31 — It is the distance from collar to the beginning of the sampled segment. The beginning of the segment is the segment's closest extremity to the collar. DFC is always a positive value.

Length of Sampled Segment (LØSS)

Columns 32 to 37 — LØSS is always the length of the drilled interval. It is not necessarily the actual recovered drilled core length.

Dip of Segment (DOS)

Columns 38 to 40 — This is the dip (in degrees) of the drillhole at the beginning of the segment. The DOS is downward negative and upward positive. DOS is not specified when sheet DAMH is used.

Azimuth of Segment (AOS)

Columns 41 to 43 — This is the azimuth (in degrees) of the drillhole at the beginning of the segment. The angle is measured clockwise from the geographical north.

"Zone Code" (ZC)

Columns 44 to 46 — This identifies either a stratigraphic geological unit or a typical mineralized zone within the deposit. The same zone code cannot alternate with other zone codes, i.e., the segments within a typical mineralized zone must be adjacent to each other.

Rock Type (RT)

Columns 47 to 52 — This identifies the rock type of the core sample. This code is assigned by the company.

47 and 48 - Rock name

49 and 50 - Mineralization or chemical property

51 and 52 - Physical property.

(For more explanations see detailed discussion in Section 3.2.7, page 22 and 23.)

Structural Information (SI)

Columns 53 to 55 — MEG has chosen three variables to identify the structural features of the hostrock of a core sample:

Column 53: Angle (a) of Dominant Discontinuity, from 1 to 9. It is the maximum angle between a horizontal plane and the plane of discontinuity measured in tens of degrees.

Column 54: Type (T) of Discontinuity

0, If material (fracture filling etc.) is absent in the dominant discontinuity.

1, If material is present in the dominant discontinuity.

2, If slickensiding is observed on the plane of the dominant discontinuity.

3, If the core is mainly schistose, i.e., the repetitive discontinuities are less than 2 mm.

4, If the core shows shaly or slaty cleavage with repetitive discontinuities from 2 mm to 2 cm apart.

Column 55: Number (N) of Natural Discontinuities from 1 to 8. Number (9) is used to indicate that the number of natural discontinuities inside the segment is greater than (8).

Mined-out Code (MOC)

Column 56 — If the segment has been or will be mined-out in the near future, enter the letter M.

% Core Recovery (PCR)

Columns 57 to 58 — This is the ratio (x 100) between the length of the core recovered and the length of the drilled interval. If the core recovery is 100% enter -1.

Density Measurement Method

Columns 63 to 64 — Self explanatory (see MEG codes, page 22).

Dry Bulk Density (DBD)

Columns 65 to 68 — Dry bulk density is the density of the rock unaffected by moisture.

Wet Bulk Density (WBD)

Columns 69 to 72 — Wet bulk density is the density of the rock with moisture.

Porosity (P)

Columns 73 to 76 — It is the percentage of pore spaces in the sample.

Reserved for MEG Use

Columns 77 to 80 — Self-explanatory.

DETAILED DESCRIPTION OF SHEET B

MEG Drillhole Number (MDN)

Columns 1 to 7 — The MDN is the same as the MDN on the Title Sheet - Line 1. MDN must be entered at the top of the sheet only. However, the keypunch operator should be aware that MDN must be keypunched for each line number.

Sheet Type (ST)

Column 8 — Always B (pre-printed) and keypunched for each line number.

Line Number (LN)

Column 9 to 11 — Same as the line number for the same segment on Sheet A.

Intercalation (INT)

Column 12 — Same as the intercalation for the same segment on Sheet A.

Radiometric Instrument (RI)

Columns 13 to 15 — This code identifies the instrument used in determining the radioactivity of the segment. This code is assigned by MEG (see MEG Codes, page 21). The two first letters identify the

radiometric instrument and a number in the last column will differentiate between a set of regression equations which give the uranium grade as a function of the radioactivity.

Total Radioactivity (TR)

Columns 16 to 21 — This is the total radioactivity (Gamma Rays) of the segment, measured in counts per second, in the case where the instrument cannot differentiate between emitting sources.

Assaying Method (Uranium) (AMU)

Column 22 — Identifies the assaying method used to determine the grade of uranium. This code is assigned by MEG (see MEG Codes, page 20.)

Uranium Grade (UG)

Columns 22 to 28 — This is the grade of uranium in the core segment. High assay values should not be cut.

Uranium Radioactivity (UR)

Columns 29 to 33 — This is the uranium radioactivity (Gamma Rays) in counts per second, available only with a spectrometer.

Assaying Method (Thorium) (AMT)

Column 34 — Identifies the assaying method used to determine the grade of thorium. (See MEG Codes, page 20.)

Thorium Grade (TG)

Columns 35 to 40 — This is the grade of thorium in the core segment. High assay values should not be cut.

Thorium Radioactivity (TR)

Columns 41 to 45 — This is the thorium radioactivity (Gamma Rays) in counts per second, available only with a spectrometer.

Assaying Method for other Metals (AS1,...AS5)

Columns 46, 52, 58, 64, 70 — These codes identify the assaying methods used to determine the grade of metals other than uranium or thorium. (See MEG Codes, page 20.)

% Other Grade (OG1,...OG5)

Columns 47 to 51(1) 53 to 57(2) 59 to 63(3) 65 to 69(4) 71 to 75(5)

These grades must be expressed as percentages except in the cases of noble metals where the grades are expressed in troy oz/short ton or grams/metric ton, depending on the code for the metal (Sheet No. 1 - line 1). (See MEG Codes for other metals, page 20.) High assay values should not be cut.

Reserved for MEG Use

Columns 77 to 80

Self-explanatory.

CHAPTER 3

CODING NOTES AND MEG CODES

CODING NOTES

There are unlabeled columns on the coding sheets. Some may be used in the future to code additional information. This applies to the following:

Title Sheet - line 1,	columns 41 to 44
Title Sheet - line 1,	columns 75 to 76
Title Sheet - line 2,	columns 35 to 53
Sheet A	columns 53 to 55
Sheet A	columns 59 to 62
Sheet B	column 70.

Other unlabeled columns must remain as they are. This applies to the following:

Title Sheet - line 1, 2 and 3,	columns 8 to 10
Title Sheet - line 1, 2 and 3,	column 12
DAMH Sheet	column 8 to 9.

It is recommended that the sample Codification Sheets be filled out with a pencil.

Data that is the same for several consecutive samples segments need not be entered repeatedly. Instead, enter the first and the last occurrence of the data and draw a vertical "wavy" line between the two values. The "wavy" line must not be carried over the next sheet. Therefore, the repeated value must be entered on the bottom line of one sheet and if the data continues to be the same, on the top line of the next sheet.

Draw a horizontal line across sheets A and B after the last segment of the drillhole and across sheet DAMH after the last measurement of dip and azimuth of the hole.

There are certain conventions for coding letters and digits. The most important ones are shown below. The conventions should be followed in order to avoid misinterpretation by keypunch operators.

MEG CODES

1	digit 1	S	letter S
I	letter I	4	digit 4
/	slash	H	letter H
2	digit 2	9	digit 9
Z	letter Z	6	digit 6
7	digit 7	G	letter G
O	zero	R	letter R
Ø	letter O	B	letter B
5	digit 5	8	digit 8

The following are examples of <u>improper</u> coding:

/	for digit 1
1	for digit 1
I	for letter I
2	for letter Z
7	for digit 7
O	for letter O
S	for letter S or digit 5
H	for letter H
4	for digit 4
G	for letter G
B	for letter R

<u>Please, use only capital letters</u>.

Unit Codes		Code
Length 1	Imperial (feet, inches)	1
Length 2	Metric (meters, milimeters)	2
Grade	pounds/ton (U_3O_8, ThO_2)	1
	% U_3O_8, ThO_2	2
	% U, Th	3
Density	grams/cubic centimeter, or metric tonnes/cubic meter	1
	pounds/cubic feet	2
	tons/cubic yard	3

Codes for other metals	Codes
nickel (%)	05
molybdenum (%)	07
gold (in troy oz/ton)	09
gold (in grams/tonne)	11
silver (in troy oz/ton)	13
silver (in grams/tonne)	15
platinum (in troy oz/ton)	17
platinum (in grams/tonne)	19
copper (%)	21
CO_3 (%)	23
lead (%)	25
Arsenic (%)	27
Cobalt (%)	29
Sulphur (%)	31
Iron (%)	33

Additional elements may be coded but their code number must be standardized with MEG.

Sampling methods

missing sampled segment	0
chip sample	1
channel sample	2
underground DDH	3
surface DDH	4
percussion drillhole	5
blast hole	6
scanner sample	7
unknown sampling method	8
dummy segment inserted by MEG	U

Assaying method

no assay	0
radiometry only of core - scanning	A
- assaying	B
radiometry only of hole	C

chemical assay only	- fluorometry	D
	- colorimetry	E
	- volumetry	F
radiometric scan of core and chemical assay	- fluorometry	G
	- colorimetry	H
	- volumetry	I
radiometric assay of core and chemical assay	- fluorometry	J
	- colorimetry	K
	- volumetry	L
radiometry of hole and chemical assay of core cuttings	- fluorometry	M
	- colorimetry	N
	- volumetry	P
estimated grade using densities		Q
radiometry of hole and radiometric scan of core or cuttings		R
radiometry of hole and radiometric assay of core or cuttings		S
geologist estimate		T
X-Ray fluorescence (XRF) assay		U
atomic absorption (not uranium)		V
delayed neutron activation		W
unknown assaying method		X

Radiometric instruments

simple geiger tube	GT
multiple geiger (scanner)	MG
simple scintillometer	SS
energy source differentiating scintillometer (multi-channel spectrometer)	ES

Other radiometric instruments may be added to this list but their code symbols must be standardized with MEG. The third column is to identify the regression equation used for each instrument.

Codes for drillhole survey instruments

acid test	1
transit survey (short holes, at collar only)	2
magnetic drillhole survey	
(tropari) single-shot	3
multi-shots	4
gyroscopic drillhole survey	
single-shot	5
multi-shots	6
photographic drillhole survey	7
(ABEM reflex-fotobor)	

DENSITY MEASUREMENT METHODS

displacement of a liquid	1
lost in weight by immersion in water	2
picnometer or heavy liquid plus west phal	
balance (fine grain)	3
geophysical instrument	4

Rock types

Six columns (from column 47 to 52) are available on Sheet A to describe the rock type. The coded information can be alphabetic and/or numeric.

One of the purposes of using a code to describe the type of rock can be to geologically interpret the grade of a rock in the case where no assay was taken. Other purposes would be to identify the faults in a mine or simply to correlate the geological strata. The purpose of using a rock code is not only to provide a geological description but also a possible statistical ranking scale of the grade in the rock.

We are suggesting some ideas for a possible utilization of the six columns available to us.

Columns 47 to 48 — ROCK NAME: This name does not need to be a petrographic or genetic name. It is only a grouping tool for reserve calculation and should be broad enough that even a semi-trained

sampler could apply it upon naked eye examination of the drillcore. A good example is the coding classification of the Elliot Lake host formation for our coding purposes:

Rock Names	Codes
conglomerate	C
pebble quartzite	P
quartzite	Q

Columns 49 to 50 — MINERALIZATION: We use these two columns to describe features of greatest significance in indicating the possible presence of uranium. This could be: colour, alteration, enrichment by some mineral, or any other chemical property of the rock discernible with the naked eye.

Columns 51 to 52 — PHYSICAL PROPERTY: Fracturing, grainsize, shearing or any physical property of the rock which will indirectly describe the favourability of the rock as a potential host for uranium mineralization.

CHAPTER 4

PRACTICAL EXAMPLES SHOWING HOW TO USE THE CODING SHEETS

GENERAL

The first two examples show how two short underground holes can be combined. The resultant combination of the two holes usually intersects all the mineralized zones of the deposit. The need to combine holes occurs when a drift is excavated inside the main ore zone. The holes are drilled in opposite directions and their collars are on the parallel faces of the drift. A face, chip or muck sample is taken to be the grade of the missing core between the collars of the two holes.

The third and last example represents a long surface hole which has been wedged.

FIRST EXAMPLE - A SHORT UNDERGROUND HOLE TITLE SHEET - FIRST LINE (SEE FIG. 4)

- To identify the deposit MEG has given a fictitious series ZZX. Number 2 in column 20 indicates that the following hole (ZZX0039) is to be combined with this hole.
- All measures of length are to be read in feet.
- The instrument used to measure the dip and azimuth of the hole at collar was a theodolite.
- The length of all 20 segments is 60.5 ft.
- The dip of the ore zone within the vicinity of the hole is 60°, the azimuth of the dip of the ore zone at this location is 170°.

TITLE-SHEET - SECOND LINE (SEE FIG. 5)

The diamond drill is identified as AXT which gives a 1-7/8" hole diameter.

TITLE-SHEET - THIRD LINE (SEE FIG. 5)

The hole is an underground hole located at the 200th level and intersecting the mineralized zone K.

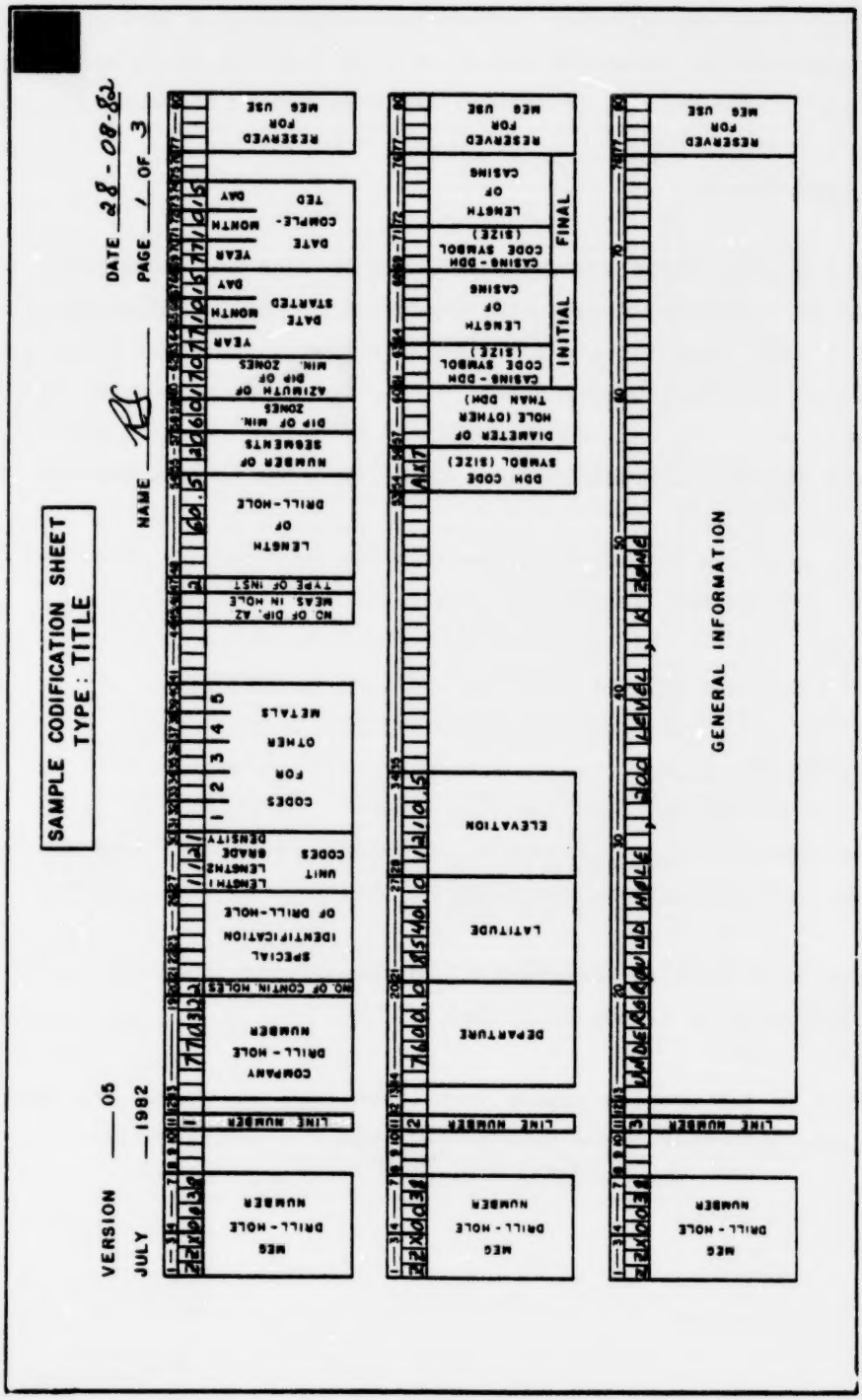

Fig. 4 - First example - title sheet

SHEET DAMH - (DIP AND AZIMUTH MEASUREMENTS OF THE HOLE)

DAMH sheet was not used because hole ZZX0038 is a straight hole. Consequently, column 45 and 46 of line 1 of the title sheet are left blank. The hole is horizontal and directed to the south.

SHEET - A (SEE FIG. 5)

The symbols which are the same for more than two segments do no have to be repeated. A wavy line indicates to the keypunch operator that the upper symbols have to be punched again. On sheet A the symbols (32-) for the sample number, (3) for the sampling method, (K) for the zone code, (-1) which indicates 100% core recovery and (2.67) for the dry bulk density have to be repeated in this manner.

The sampling method indicates that the core samples were taken from an underground diamond-drill hole.

No rock type was available at the time of coding.

SHEET - B (SEE FIG. 6)

An energy source differentiating scintillometer was used to measure the radioactivity in the hole.

The total counts, the uranium and the thorium counts are given. The radioactivity is not corrected.

Most of the uranium assays were taken from the core. The thorium grade will have to be interpreted from the radioactivity of thorium.

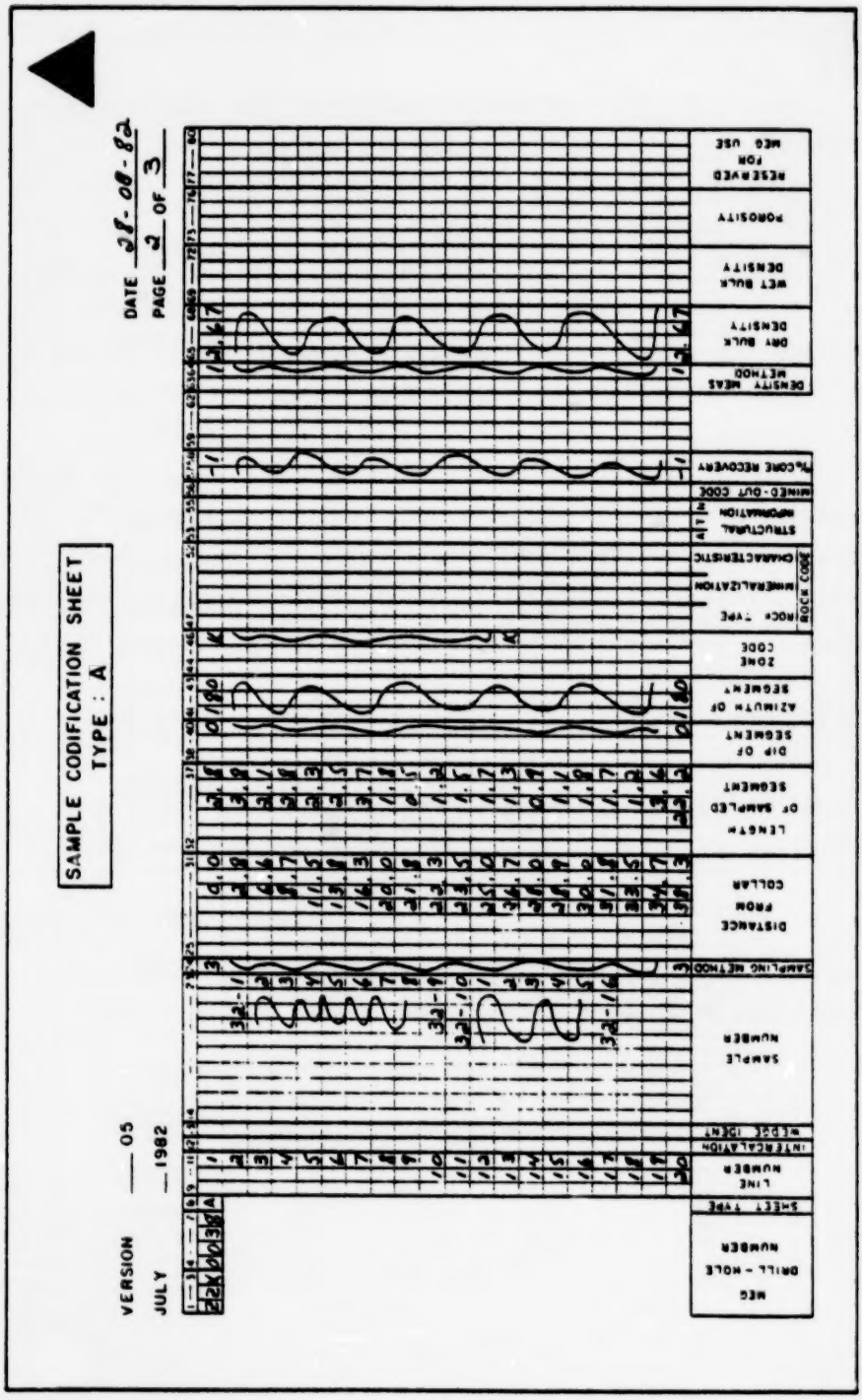

Fig. 5 - First example - sheet A

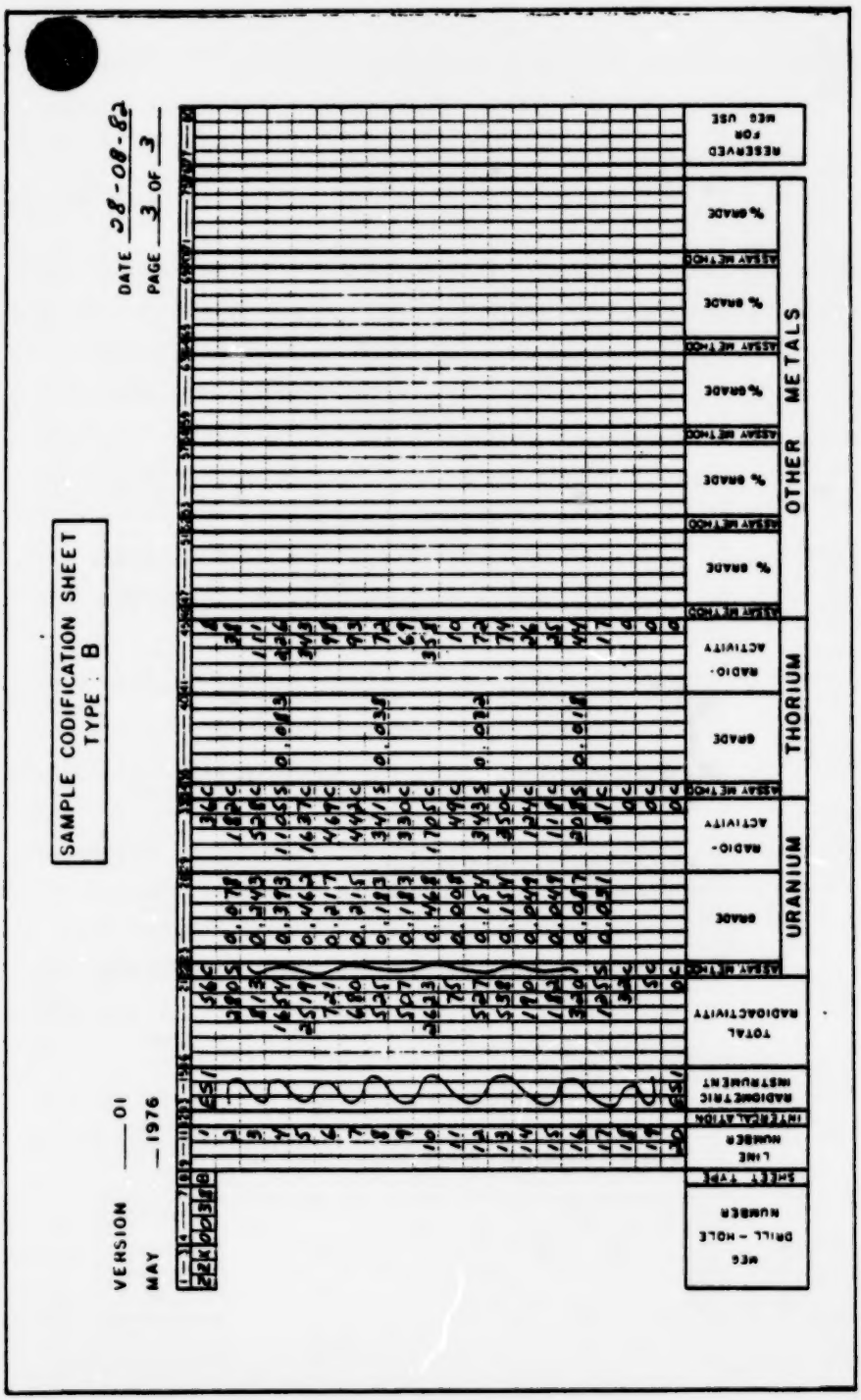

Fig. 6 - First example - sheet B

SECOND EXAMPLE - ANOTHER SHORT UNDERGROUND HOLE TO BE COMBINED WITH THE FIRST ONE

TITLE SHEET - FIRST LINE (SEE FIG. 7)

Gold assays have been taken. Gold is identified by the code 09 in columns 31 and 32.

TITLE SHEET - SECOND AND THIRD LINE (SEE FIG. 7)

This drillhole has the same departure and elevation as the first hole. There is only an 11.7 feet distance between the two hole. This hole intersects both K and P mineralized zones.

SHEET DAMH

DAMH sheet was not used because hole ZZX0039 is a straight hole. However, two face samples have been coded with the core samples. On sheet A, one measure of dip and azimuth of segment is given for the face samples and one for the drillhole samples.

SHEET A - (SEE FIGS. 8 AND 10)

The two first segments are face samples oriented toward the south. The other segments are core samples oriented toward the north. The mined out portion of the orebody is indicated by an (M) in column 56.

SHEET B - (SEE FIGS. 9 AND 11)

Most of the uranium assays are derived from the radioactivity of core. The gold assays are given in troy ounces per short ton.

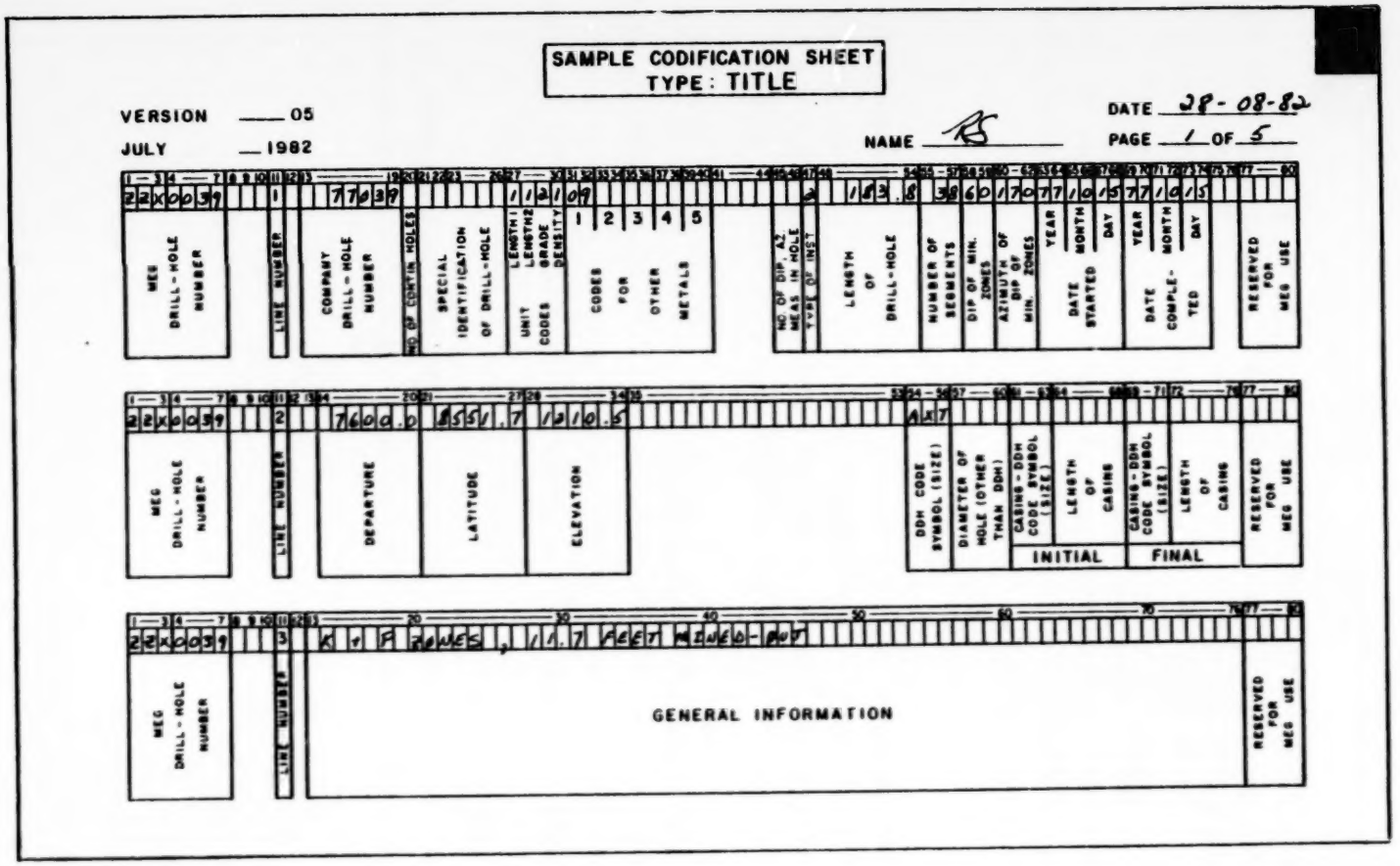

Fig. 7 - Second example - title sheet

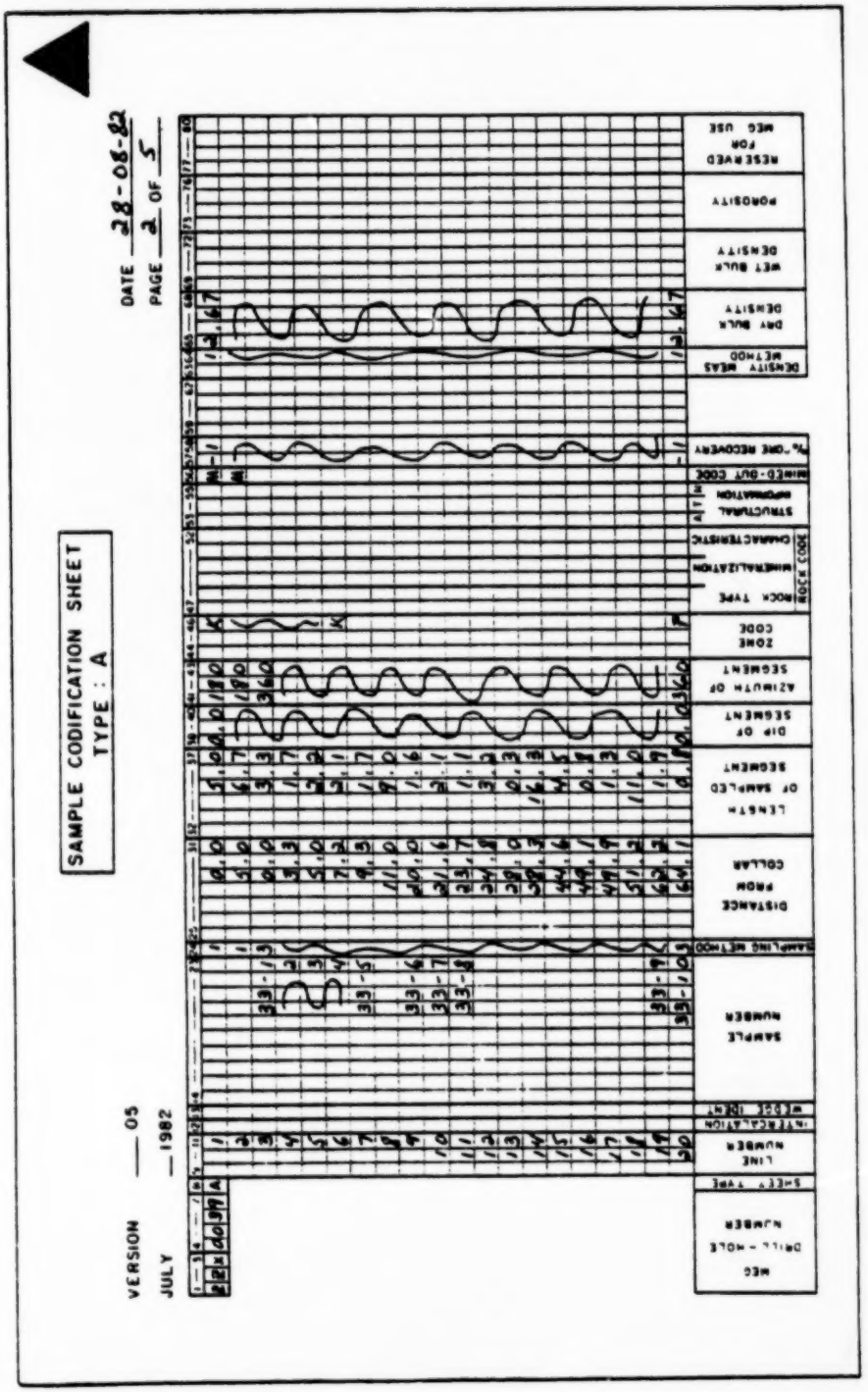

Fig. 8 - Second example - sheet A

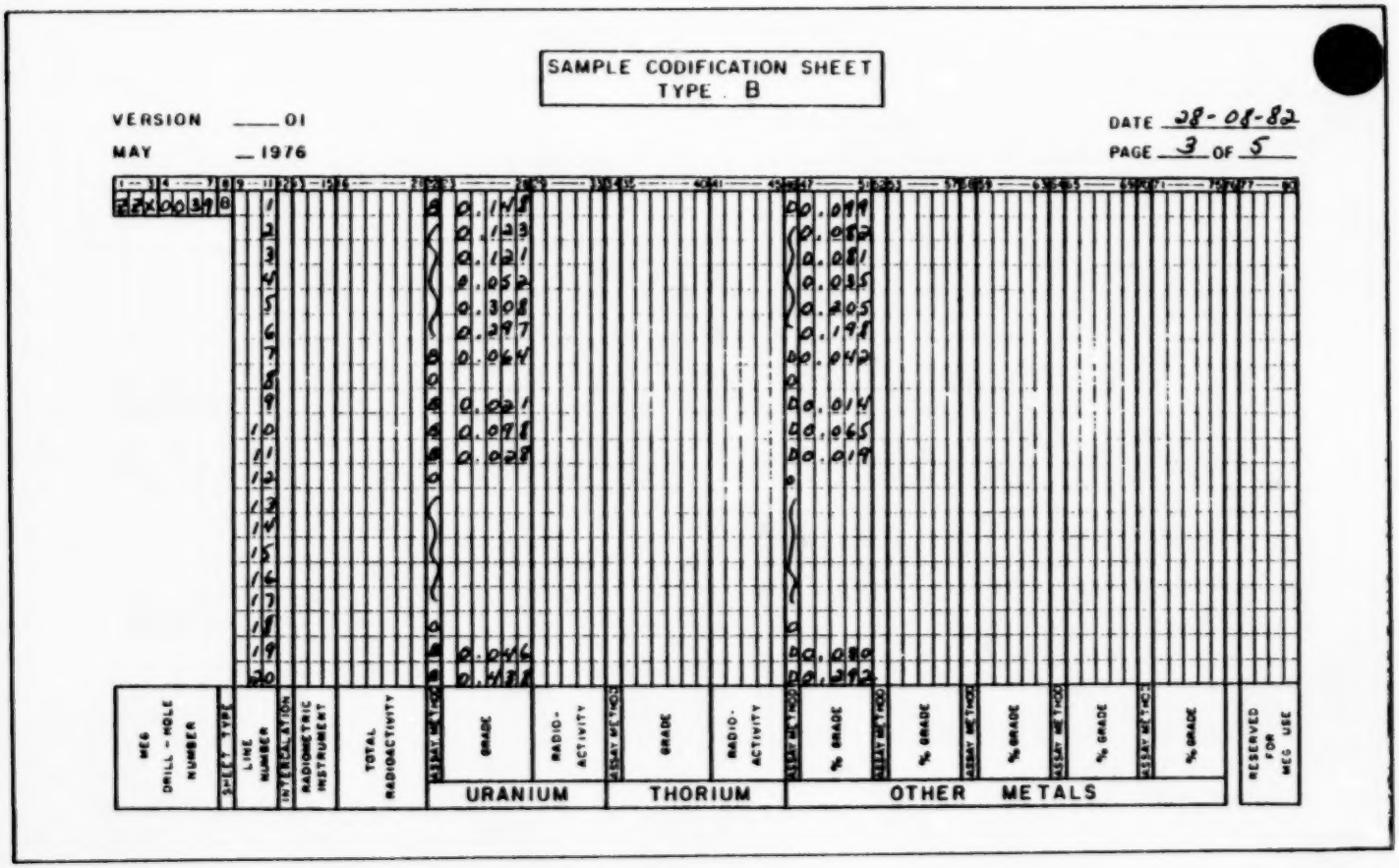

Fig. 9 - Second example - sheet B

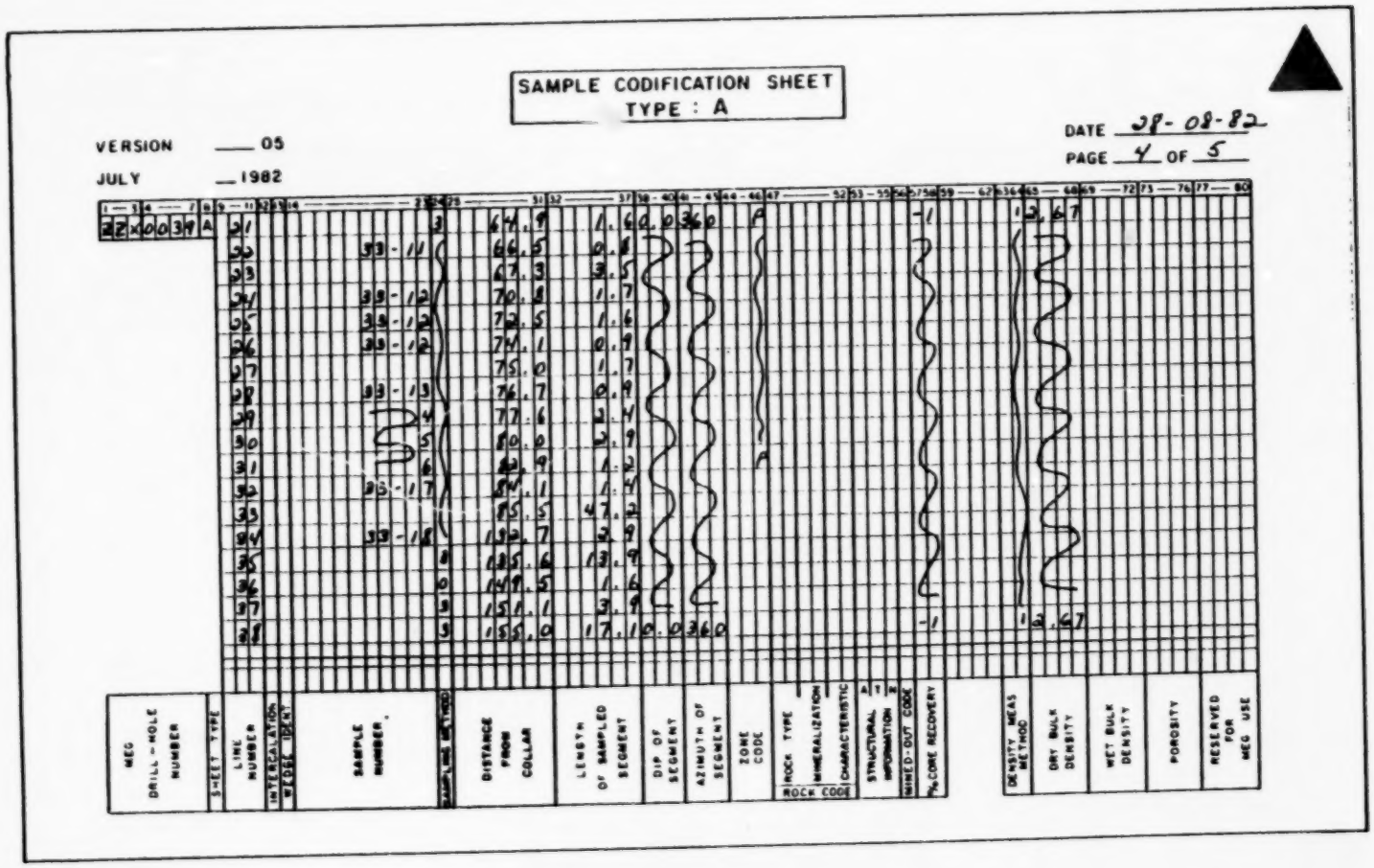

Fig. 10 - Second example - sheet A

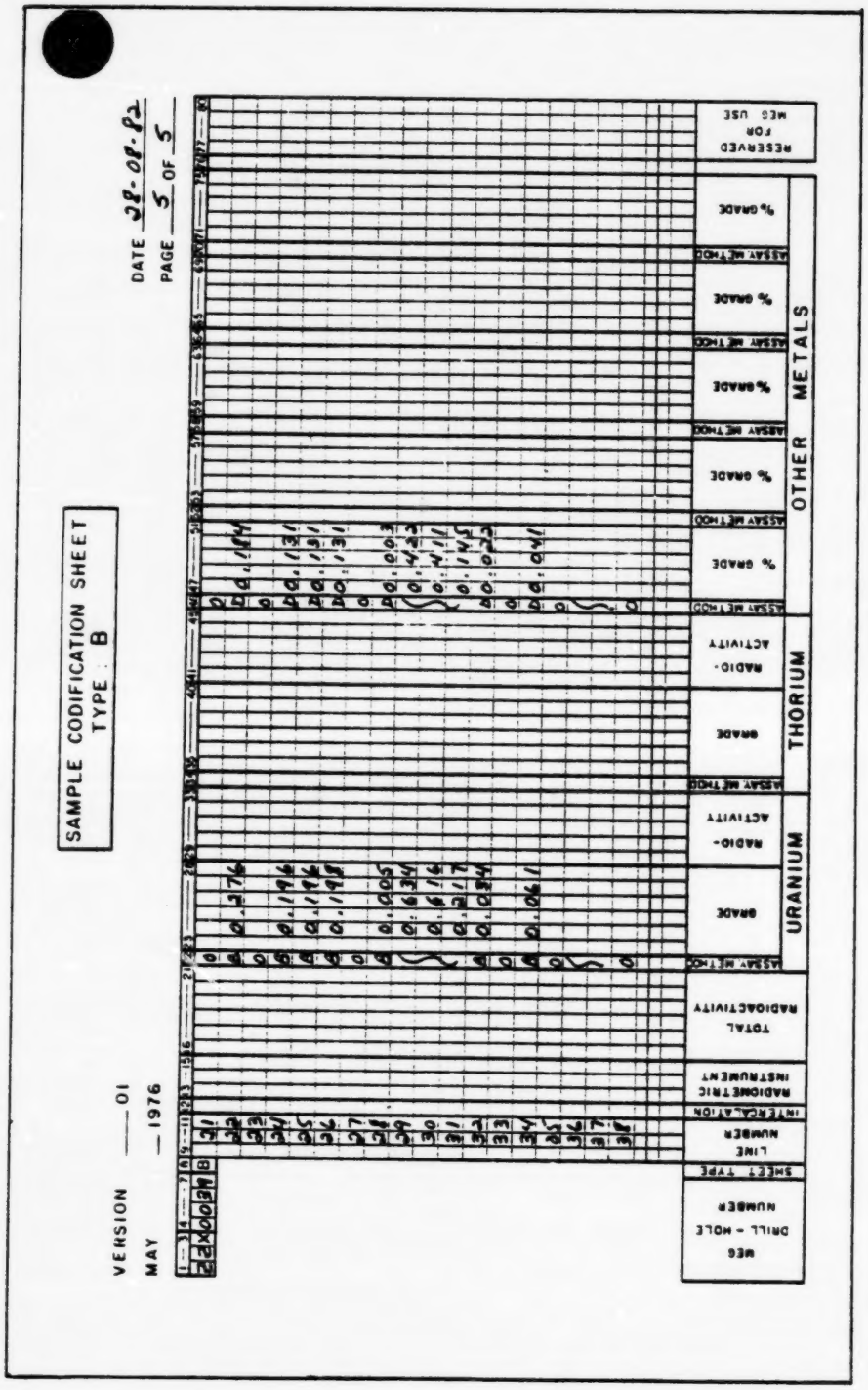

Fig. 11 – Second example – sheet B

THIRD EXAMPLE - A LONG SURFACE HOLE

TITLE SHEET - FIRST LINE (SEE FIG. 12)

The dip and azimuth of the hole was measured by a magnetic single shot instrument.

Six measurements were taken down the hole and two down the wedge.

TITLE SHEET - SECOND LINE (SEE FIG. 12)

The DDH code is BWG which will give a core diameter of 1 21/32 inches. The casing used was a BW.

SHEET - DAMH (SEE FIG. 13)

A linear interpolation of the dip and azimuth of the hole will be calculated between two measurements of the hole orientation.

The dip and azimuth of the hole will vary linearly between two measurements.

SHEET - A (SEE FIG. 14)

A wedge was made at 1700 ft from collar.

The segment in the casing was not considered at the beginning of the coding.

We must code all parts of the hole even if the recovery is zero or if it is waste. The total length of the segments must be equal to the length of the hole.

A rock code was given by the geologist.

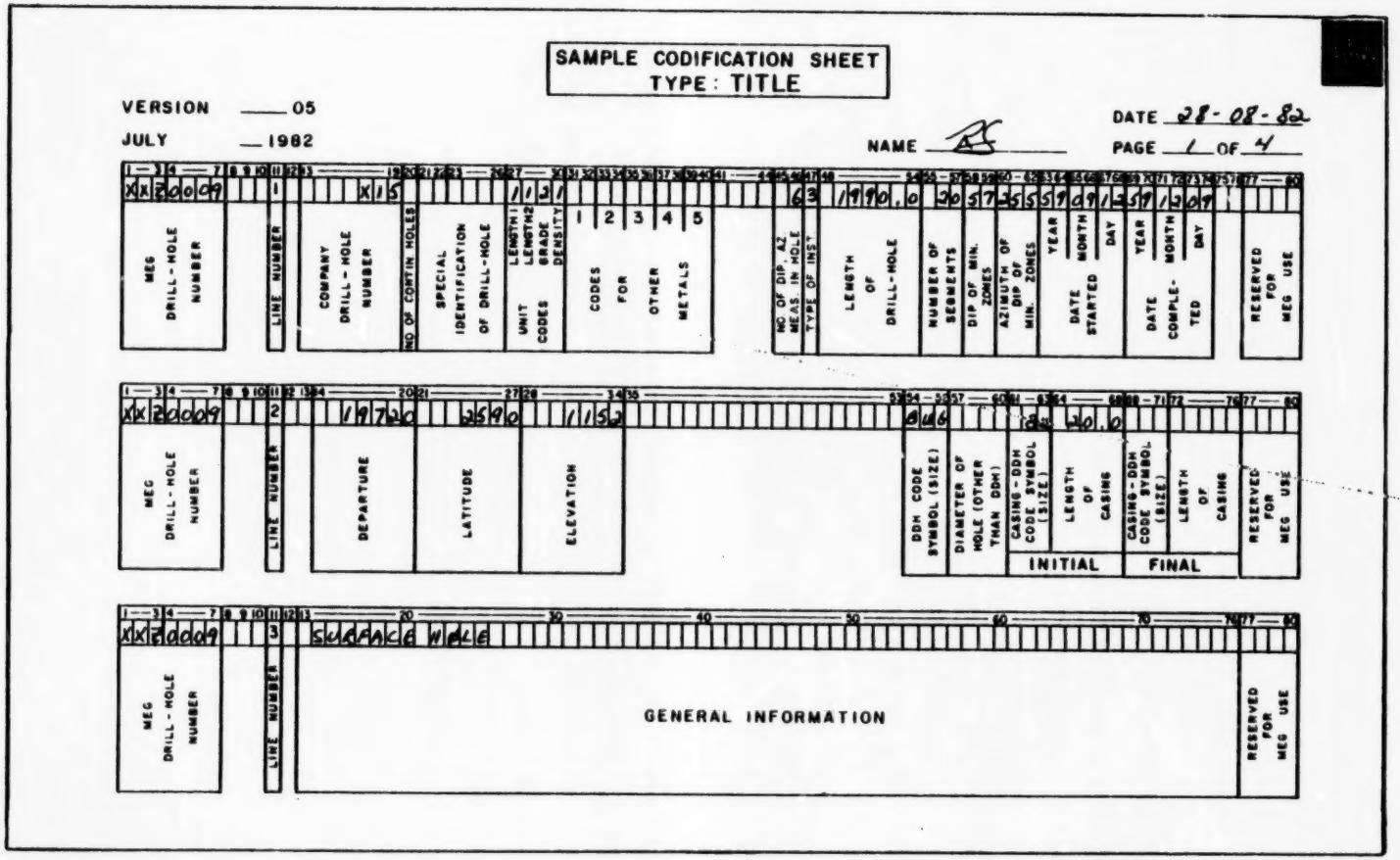

Fig. 12 - Third example - title sheet

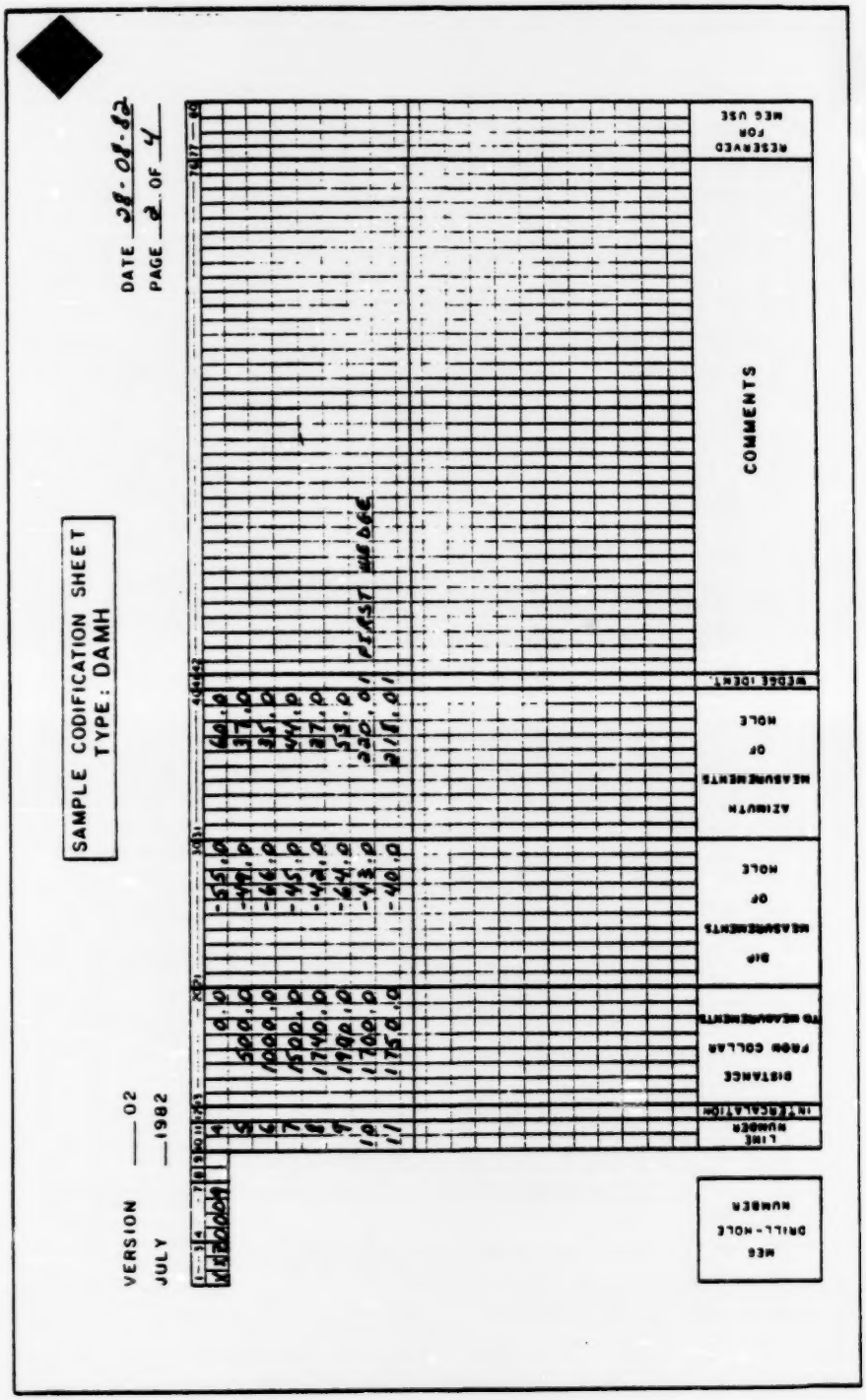

Fig. 13 - Third example - sheet DAMH

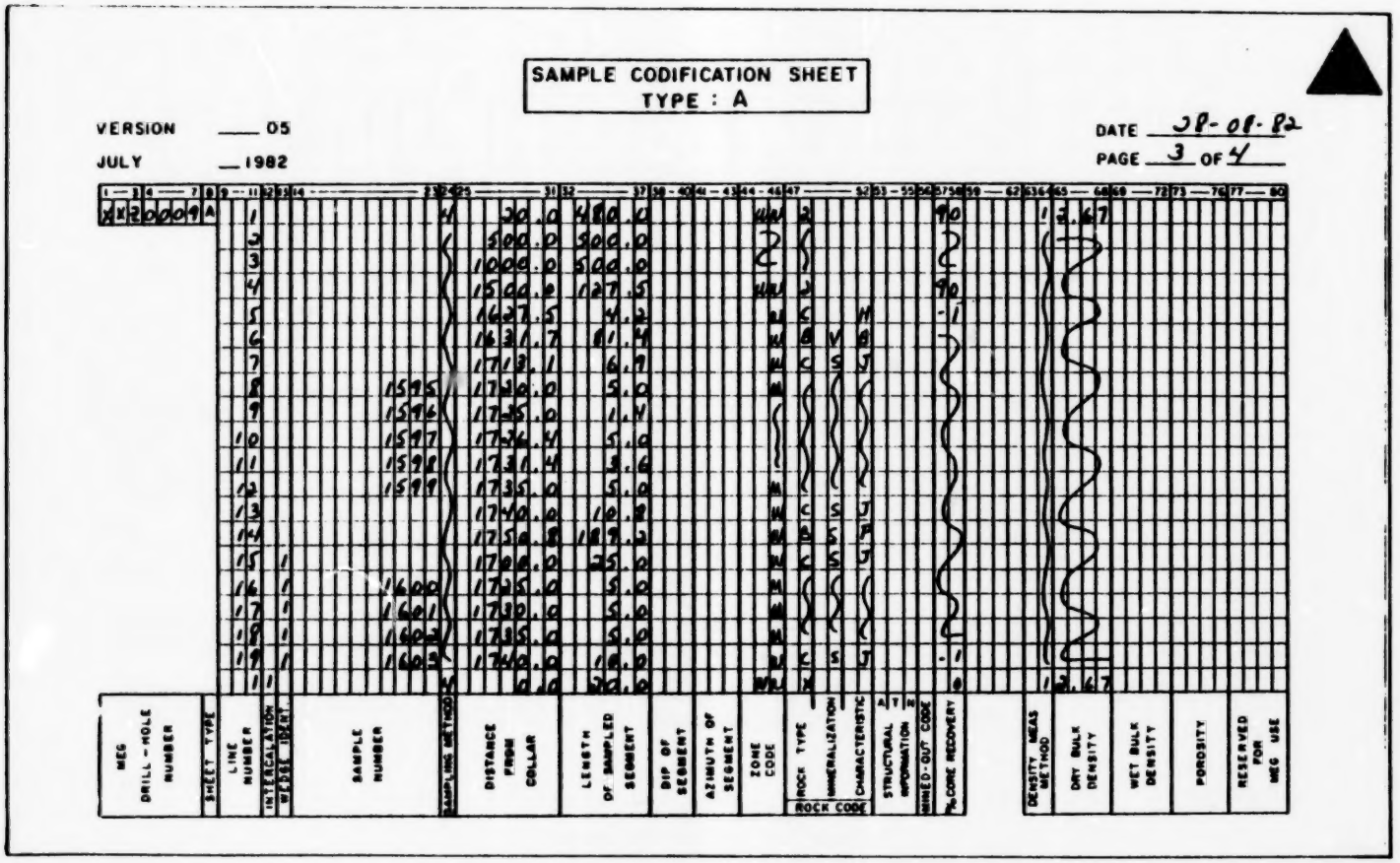

Fig. 14 - Third example - sheet A

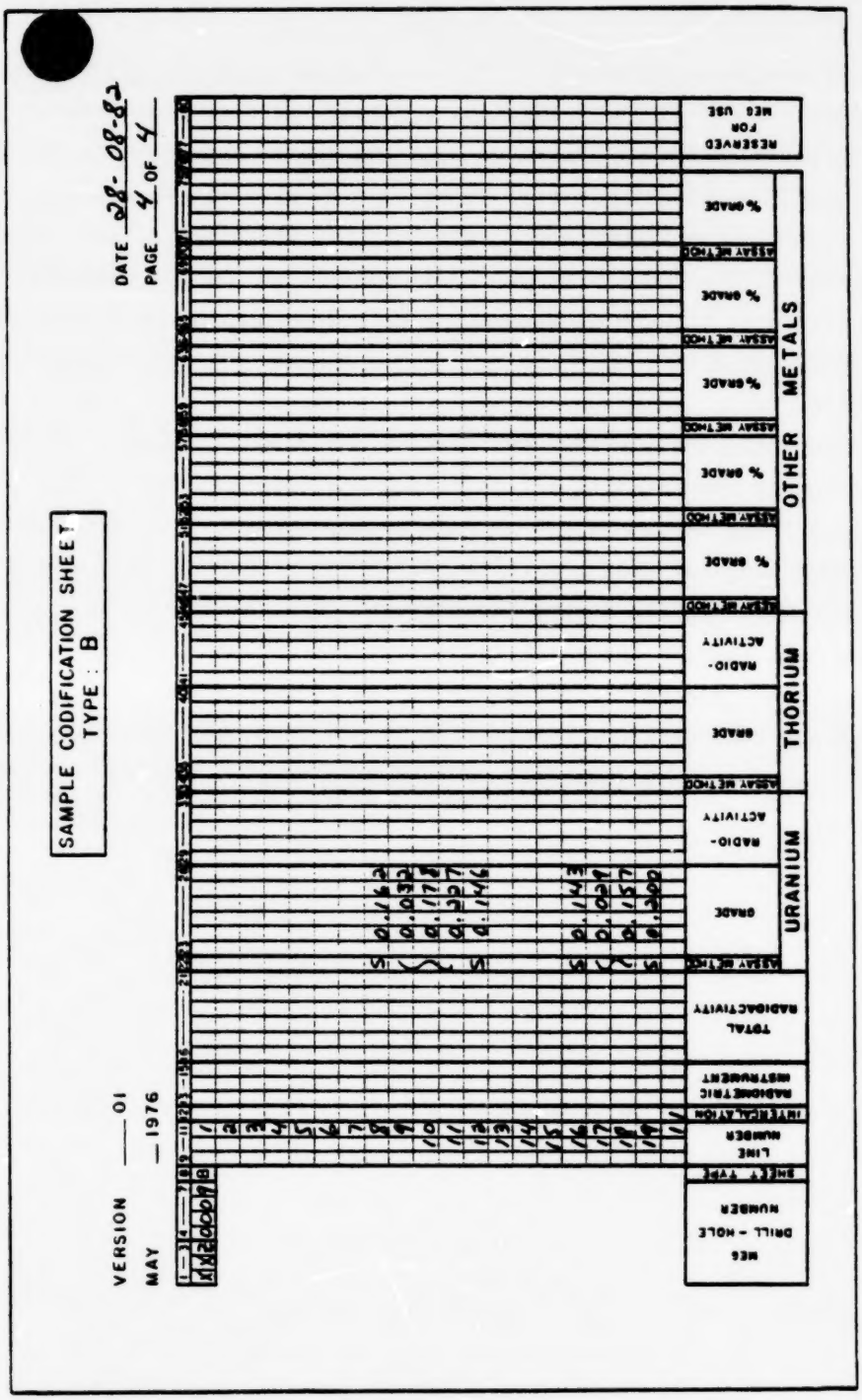

Fig. 15 - Third example - sheet B

ACKNOWLEDGEMENT

The creation of coding sheets was for our group the master key which made it possible to develop a completely integrated system of programs to evaluate uranium reserves. First, I must express my appreciation for the invaluable help I received from Jiri Folta (our former data analyst) for incorporating important programming concepts into the structure of the coding sheets. When Jiri started with us, I was using what I would call today an archaic version of the coding sheets. Jiri's approach was more operational and the ideas which he applied to the coding sheets have simplified their manipulation.

The collaboration of Arpad Fustos, the senior geologist of our group, was important in proofreading and rewriting the introduction of this report as well as writing section 3.2.7 on rock types. Arpad's aid was also significant in some long but useful discussions we had concerning drilling and assaying practices in the mining industry.

I must finally thank all those of our group who directly or indirectly helped to improve the structure or the content of the coding sheets.

Since the beginning, the coding sheets have been continually revised, I hope, for the best. I thus believe that this version will not be the final one.

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1. SME, "Mining engineering handbook", vol 1 and 2, Cummins, Given; 1973.

2. Mead, Warren, J. "Relation of density, porosity and moisture to specific volumes of ores"; Economic Geology, vol III, No. 4; 1963.

3. McKinstry, Hugh Exton "Mining geology"; Prentice-Hall Geology series; 1948.